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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/718,192	11/20/2003	Yian-Liang Kuo	TS03-336	9795
7590 03/25/2005 STEPHEN B. ACKERMAN 28 DAVIS AVENUE POUGHKEEPSIE, NY 12603			EXAMINER CHU, CHRIS C	
			ART UNIT 2815	PAPER NUMBER

DATE MAILED: 03/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/718,192	Applicant(s) KUO ET AL.	
	Examiner Chris C. Chu	Art Unit 2815	(RM)

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 December 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 25 - 37, 41 - 53 and 57 - 62 is/are pending in the application.
- 4a) Of the above claim(s) 57 - 62 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 25 - 29, 31 - 37, 41 - 45 and 47 - 53 is/are rejected.
- 7) ☒ Claim(s) 30 and 46 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 November 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. Applicant's amendment filed on December 27, 2004 has been received and entered in the case.

Election/Restrictions

2. Newly submitted claims 57 – 62 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: the claims 57 – 62 are drawn to a Species II because the claims 57 – 62 recite the pillar between the substrate and the heat spreader. Since applicant elected Species I (Fig. 2A), the claims 57 – 62 are withdrawn from consideration as being directed to a non-elected invention.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 57 – 62 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Drawings

3. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the limitation in claim 41 “a PCB substrate or a stiffener mounted to the heat spreader” must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled “Replacement Sheet” in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

On page 14, Applicant states “applicant respectfully submits herewith a sheet of drawings including Figs. 3A and 3B to be entered in the application.” However, the Figs. 3A and 3B were not found with applicant’s transmittal. Thus, this objection for the drawings is maintained.

Claim Objections

4. Claims 25 and 36 are objected to because of the following informalities:

In claim 25, line 5, “form” misspelled, and

In claim 36, line 2, “amounted” misspelled.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 25 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. in view of Khatri (U. S. Pat. No. 6,610,635).

Regarding claim 25, Juskey et al. discloses in e.g., Fig. 4 a heat spreader ball grid array package, comprising:

- a ball grid substrate (10);
- a semiconductor chip (16) affixed to the ball grid substrate;
- a molding compound (20) encasing the semiconductor chip over the ball grid substrate;
- a heat spreader (29) mounted over the ball grid substrate and spaced apart from the molding compound to form a gap; and
- thermal grease (27) within the gap at least between the heat spreader and the molding compound.

While Juskey et al. teaches the use of the thermal grease, Juskey et al. does not appear to provide any example of the thermal grease's specific composition (i.e., silicon rubber containing zinc oxide; claim 29). Khatri teaches in column 2, lines 11 – 17 the thermal grease may be

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composed of a silicon rubber containing heat-conducting particles (e.g., zinc oxide). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the silicon rubber with heat-conducting particles between the heat spreader and the molding compound structure of Juskey et al. as taught by Khatri to reduce messy installation with easier and less time-consuming and to reduce amount of grease with each application (column 2, lines 17 – 21).

7. Claims 26, 27, 34 and 35 – 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 25 above, and further in view of Long et al. (U. S. Pat. No. 5,175,612).

Regarding claims 26 and 27, Juskey et al. and Khatri disclose in e.g., Fig. 4 the use of the semiconductor chip (column 3, line 47), the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63). However, Juskey et al. and Khatri do not appear to provide any example of the semiconductor chip's specific composition to be a silicon (claim 26), the specific epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 27). Long et al. teaches in e.g., Fig. 2 a semiconductor chip (52) material to be composed of a silicon (column 1, lines 42 – 42), an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (64) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the silicon as the specific material to form the semiconductor chip; the curing agent with the epoxy molding compound as the specific

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material to form the molding compound and the aluminum as the specific material to form the heat spreader in the structure of Juskey et al. as taught by Long et al. to provide a good heat dissipation (column 6, lines 16 – 19) by using the aluminum as the specific material to form the heat spreader in the structure.

Regarding claim 34, Since Juskey et al., Khatri and Long et al. disclose silicon semiconductor chip that has $2 \text{ to } 3 * 10^{-6}/^{\circ}\text{K}$ of the coefficient of thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), Juskey et al., Khatri and Long et al. disclose the limitation “the semiconductor chip has a coefficient of thermal expansion of from “about” $2.5 \text{ to } 3.5 * 10^{-6}/^{\circ}\text{K}$.

Regarding claims 35 – 37, while Juskey et al. and Khatri disclose in e.g., Fig. 4 the use of a heat spreader (29; column 4, line 63) and the thermal grease (27) nearly filling the gap (at the space between the molding compound and the heat sink; claim 37), Juskey et al. and Khatri do not appear to provide another example of the heat spreader’s specific shape to be an inverted square pie tin that has an elongated surrounding lip that is attached with epoxy onto the substrate (claims 35 - 37). Long et al. teaches in e.g., Fig. 3 the shape of the heat spreader (82) to be an inverted square pie tin (88) that has an elongated surrounding lip (at the “L” shape of the element 88 on the element 44B; column 7, lines 60 - 62) that is attached with epoxy (44b; column 3, lines 1 – 3) onto a substrate (48). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the shape of the inverted square pie tin with an elongated surrounding lip as the specific shape of the heat spreader that is attached with epoxy onto the substrate in the structure of Juskey et al. as taught by Long et al. to provide a pedestals or a mounting area for the heat sink (column 7, lines 60 – 61).

8. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 25 above, and further in view of Culnane et al. (U. S. Pat. No. 5,785,799).

While Juskey et al. and Khatri disclose in e.g., Fig. 4 the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63), Juskey et al. and Khatri do not appear to provide any example of the heat spreader's specific composition to be a copper. Culnane et al. teaches in e.g., Fig. 1 a heat spreader (118) material to be a copper (column 2, lines 56 - 57). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the copper as the specific material to form the heat spreader in the structure of Juskey et al. as taught by Culnane et al. to improve the thermal efficiency for removing heat from a chip to increase reliability and potentially increase power dissipation to allow a higher device density (column 2, lines 41 – 44).

9. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 25 above, and further in view of Eguchi et al. (U. S. Pat. No. 6,784,541).

While Juskey et al. and Khatri teach the use of the thermal grease, Juskey et al. and Khatri do not appear to provide any example of the thermal grease's specific composition. Eguchi et al. teaches in column 15, lines 20 – 25 the thermal grease (5) may be composed of an epoxy resin, a curing agent, a catalyst and a coupling agent. It would have been obvious to one of

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ordinary skill in the art at the time when the invention was made to further apply the epoxy resin, the curing agent, the catalyst and the coupling agent between the heat spreader and the molding compound structure of Juskey et al. and Khatri as taught by Eguchi et al. to provide voidless, no water invasion or moisture condensation and to reduce the warp of the substrate (column 15, lines 26 – 28).

10. Claims 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 25 above, and furthermore in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claims 32 and 33, Since Juskey et al., Khatri and Culnane et al. disclose the use of a copper heat spreader that has $17 * 10^{-6}/^{\circ}\text{K}$ (see column 2, lines 4 – 6 of Burgess) for the coefficient of thermal expansion, Juskey et al. and Culnane et al. disclose the limitation “the heat spreader has a coefficient of thermal expansion of about 17.0”. However, Juskey et al., Khatri and Culnane et al. do not appear to provide any example of the epoxy molding compound’s specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound’s specific range of the coefficient of thermal expansion including 10 to $60 * 10^{-6}/^{\circ}\text{K}$. Note that “about” 7.0 includes $10 * 10^{-6}/^{\circ}\text{K}$ about the same based in the metes and bounds of “about” disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to $60 * 10^{-6}/^{\circ}\text{K}$ as the specific range of the coefficient of thermal expansion for the epoxy molding compound in the structure of Juskey et al. as taught by Primeaux to further protect the

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wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

11. Claims 41 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. in view of Khatri, and further in view of Lee et al. (U. S. Pat. No. 6,362,530).

Juskey et al. discloses in e.g., Fig. 4 a heat spreader ball grid array package, comprising:

- a ball grid substrate (10);
- a semiconductor chip (16) affixed to the ball grid substrate;
- a molding compound (20) encasing the semiconductor chip over the ball grid substrate;
- thermal grease (27) over the molding compound; and
- a heat spreader (29) mounted over the ball grid substrate (10), the molding compound (20) and the thermal grease (27).

While Juskey et al. teaches the use of the thermal grease, Juskey et al. does not appear to provide any example of the thermal grease's specific composition (i.e., silicon rubber containing zinc oxide; claim 45). Khatri teaches in column 2, lines 11 – 17 the thermal grease may be composed of a silicon rubber containing heat-conducting particles (e.g., zinc oxide). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the silicon rubber with heat-conducting particles between the heat spreader and the molding compound structure of Juskey et al. as taught by Khatri to reduce messy installation with easier and less time-consuming and to reduce amount of grease with each application (column 2, lines 17 – 21).

Furthermore, Juskey et al. and Khatri do not disclose a PCB substrate mounted to the heat spreader. Lee et al. teaches in e.g., Fig. 2D a PCB substrate (240) mounted to a heat spreader (224). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the PCB substrate onto the heat spreader in the structure of Juskey et al. as taught by Lee et al. to allow the heat spreader to be directly attached to a heat dissipating pad of the printed circuit board to dissipate heat away from die through the printed circuit board (column 7, lines 52 – 57).

12. Claims 42, 43, 50 and 51 - 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al., Khatri and Lee et al. as applied to claim 41 above, and further in view of Long et al. (U. S. Pat. No. 5,175,612).

Regarding claims 42 and 43, Juskey et al., Khatri and Lee et al. disclose in e.g., Fig. 4 the use of the semiconductor chip (column 3, line 47), the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63). However, Juskey et al., Khatri and Lee et al. do not appear to provide any example of the semiconductor chip's specific composition to be a silicon (claim 26), the specific epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 27). Long et al. teaches in e.g., Fig. 2 a semiconductor chip (52) material to be composed of a silicon (column 1, lines 42 – 42), an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (79) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the silicon as the specific material

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to form the semiconductor chip; the curing agent with the epoxy molding compound as the specific material to form the molding compound and the aluminum as the specific material to form the heat spreader in the structure of Juskey et al., Khatri and Lee et al. as taught by Long et al. to (1) provide a good heat dissipation (column 6, lines 16 – 19) by using the aluminum as the specific material to form the heat spreader in the structure.

Regarding claim 50, Since Juskey et al., Khatri and Long et al. disclose silicon semiconductor chip that has $2 \text{ to } 3 \times 10^{-6}/^{\circ}\text{K}$ of the coefficient of thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), Juskey et al. and Long et al. disclose the limitation “the semiconductor chip has a coefficient of thermal expansion of from “about” $2.5 \text{ to } 3.5 \times 10^{-6}/^{\circ}\text{K}$.”

Regarding claims 51 – 53, while Juskey et al., Khatri and Lee et al. disclose in e.g., Fig. 4 the use of a heat spreader (29; column 4, line 63) and the thermal grease (27) nearly filling the gap (at the space between the molding compound and the heat sink; claim 53), Juskey et al. and Lee et al. do not appear to provide another example of the heat spreader’s specific shape to be an inverted square pie tin that has an elongated surrounding lip (claims 51 – 53) that is attached with epoxy onto the substrate. Long et al. teaches in e.g., Fig. 3 the shape of the heat spreader (82) to be an inverted square pie tin (88) that has an elongated surrounding lip (at the “L” shape of the element 88 on the element 44B; column 7, lines 60 – 62) that is attached with epoxy (44b; column 3, lines 1 – 3) onto a substrate (48). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the shape of the inverted square pie tin with an elongated surrounding lip as the specific shape of the heat spreader that is attached with epoxy onto the substrate in the structure of Juskey et al. and Lee et al. as taught by Long et al. to provide a pedestals or a mounting area for the heat sink (column 7, lines 60 – 61).

13. Claim 44 is rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al., Khatri and Lee et al. as applied to claim 41 above, and further in view of Culnane et al. (U. S. Pat. No. 5,785,799).

While Juskey et al., Khatri and Lee et al. disclose in e.g., Fig. 4 the material of the molding compound being comprised of epoxy resin (column 4, lines 8 – 14) and the use of a heat spreader (29; column 4, line 63), Juskey et al., Khatri and Lee et al. do not appear to provide any example of the heat spreader's specific composition to be a copper. Culnane et al. teaches in e.g., Fig. 1 a heat spreader (118) material to be a copper (column 2, lines 56 - 57). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the copper as the specific material to form the heat spreader in the structure of Juskey et al., Khatri and Lee et al. as taught by Culnane et al. increase reliability and potentially increase power dissipation to allow a higher device density (column 2, lines 41 – 44).

14. Claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al. and Khatri as applied to claim 41 above, and further in view of Eguchi et al. (U. S. Pat. No. 6,784,541).

While Juskey et al., Khatri and Lee et al. teach the use of the thermal grease, Juskey et al., Khatri and Lee et al. do not appear to provide any example of the thermal grease's specific composition. Eguchi et al. teaches in column 15, lines 20 – 25 the thermal grease (5) may be composed of an epoxy resin, a curing agent, a catalyst and a coupling agent. It would have been obvious to one of ordinary skill in the art at the time when the invention was made to further

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apply the epoxy resin, the curing agent, the catalyst and the coupling agent between the heat spreader and the molding compound structure of Juskey et al., Khatri and Lee et al. as taught by Eguchi et al. to provide voidless, no water invasion or moisture condensation and to reduce the warp of the substrate (column 15, lines 26 – 28).

15. Claims 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Juskey et al., Khatri and Lee et al. as applied to claim 41 above, and further in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claims 48 and 49, Since Juskey et al., Khatri and Culnane et al. disclose the use of a copper heat spreader that has $17 * 10^{-6}/^{\circ}\text{K}$ (see column 2, lines 4 – 6 of Burgess) for the coefficient of thermal expansion, Juskey et al. and Culnane et al. disclose the limitation “the heat spreader has a coefficient of thermal expansion of about 17.0”. However, Juskey et al., Khatri and Culnane et al. do not appear to provide any example of the epoxy molding compound’s specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound’s specific range of the coefficient of thermal expansion including 10 to $60 * 10^{-6}/^{\circ}\text{K}$. Note that “about” 7.0 includes $10 * 10^{-6}/^{\circ}\text{K}$ about the same based in the metes and bounds of “about” disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to $60 * 10^{-6}/^{\circ}\text{K}$ as the specific range of the coefficient of thermal expansion for the epoxy molding compound in the structure of Juskey et al. as taught by Primeaux to further protect the wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

Allowable Subject Matter

16. Claims 30 and 46 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 30 and 46 contain allowable subject matter because none of references of record teach or suggest, either singularly or in combination, at least the limitation of a thermal grease comprising an epoxy resin, a curing agent, a catalyst, a coupling agent, a filler, a flame retardant, a mold-release agent, a coloring agent and a stress-relief agent.

Response to Arguments

17. Applicant's arguments with respect to claims 25 and 41 have been considered but are moot in view of the new grounds of rejection.

Conclusion

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is 571-272-1724. The examiner can normally be reached on 10:30 - 8:00.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 517-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from

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either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chris C. Chu
Examiner
Art Unit 2815

C.C.
Wednesday, March 16, 2005


GEORGE ECKERT
PRIMARY EXAMINER